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EMPIRICAL ANALYSIS OF FINANCIAL PERFORMANCE OF SELECTED INDIAN TELECOMMUNICATION COMPANIES USING TOPSIS METHOD

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ABSTRACT

Corporate financial assessment is one of the focal areas in the industry. It indicates the company position among its counterparts based on various criteria of performance. Financial performance analysis supports to the companies for maintain the share and profits. It suggests the ways and means to be adopted by the weak companies in order to improve their position. Further, top companies adopting various plans and strategies for further strengthening of their position in the market. TOPSIS is the most appropriate techniques widely applied in science, business and government. Therefore, an attempt has been made in this study to apply the MCDM model for financial assessment of Indian telecommunication companies and rank accordingly based on various financial criteria. The data were collected for the study between 2007-08 to 2018-19. The study established that Airtel had the best performance of the study period. MTNL had the least performance of the study period.

KEYWORDS: Financial Assessment, MCDM, TOPSIS Method, Indian Telecommunication Industry, Entropy Method, Financial Soundness, Decision Making

1. INTRODUCTION

Corporate financial assessment is one of the focal areas in the industry. It indicates the company position among its counterparts based on various criteria of performance. It shows how much distance the weak companies to distinguish from top one. It suggests the ways and means to be adopted by the weak companies in order to improve their position. Further, top companies adopting various plans and strategies for further strengthening of their position in the market. (Sahar Omrani et al.)[1]. With the help of financial performance assessment, stakeholders has to decide about their position in the company and also understand how much companies struggled for them by providing better return on their investment. While making financial performance decision- making, the number of criteria has to be considered. Such criterion is to be divided in to two categories such as financial and non-financial criteria's. The various financial criteria's includes earning capacity, utilization of resources, financial soundness and paying ability, management efficiency and stock valuation, etc. The non-financial criteria's includes network coverage, generation advancement, internet speed and customer satisfaction about service and maintenance of instruments etc. In the present corporate world, most of the companies provide misleading information about their performance to the investors in order to attract and retain them.

While taking decision, one has to take in to account various criteria's and compare it **(Turskis et al 2009)**[2]. The problem in decision making is to find out superior one and describe how all the criteria considered simultaneously for taking decision **(Zavadskas and Turskis 2010)**[3]. This is possible through MCDM models. It is the most appropriate techniques widely applied in science, business and government. Therefore, an attempt has been made in this study to apply the MCDM model for financial assessment of Indian telecommunication companies and rank accordingly based on various financial criteria.

2. METHOD

2.1 Indian telecommunication industry

The India's telecommunication is the second largest network in the world. Telecommunication is growing now a day due to high demand from the customers. Plenty of mobile data plan and services are designed according to modern people life style. Since the company desires to upgrade its system, network speed as well as coverage, its requires a huge amount of financial support to achieve the goal. The telecom industry has contributed to the all round growth of the economy and there is no gain saying the contribution of the public sector role. Internet use is an important parameter to increasing of telecommunication and ICT resources. The telecommunication has supported the socio economic development of India and has significant to narrow down the rural-urban digital divide to some extent. The Government has pragmatically used modern telecommunication facilities to deliver mass education programmers for the rural folk of India. Along with the government owned telecom units, the Indian telecom market has also attracted many private operators to enter here who started offering their telecom services as fixed communication, mobile communication and data services to the customers at the most reasonable prices. The telecom industry is inevitable as "co-existence" of both public and private is the spirit of Indian political economy.

Telecommunication is one of the prime services required for fast growth and modernization of various sectors of the economy. Indian telecom sector and mobile telephony specifically has got the creative ability of India by progressive way the convey, offer data and through it amazing development helped million stay connected. Telecommunications operating under one of the most dynamic sector in Indian economy of identify key financial attributes of telecom companies and their respective impact. The term globalization shrinks the whole world in one hand that is because of telecom industries. The telecom plays a vital in economic growth of our country such as GDP, employment

generation, trade and investment. It is believed that a one per cent improvement in telecom penetration results in more than 3 per cent growth in GDP.

2.2 Justification of the Study

The government of India has adopted several measures to provide a business friendly environment for Indian telecommunication companies. The improvement in the standard of living and the development of infrastructure and connectivity are some of the main reasons for the significant growth of the telecom industry. The growth is expected to be more over the years. The Indian telecom sector has emerged as one of the critical components of economic growth required for over all socio-economic development of the country the penetration of mobile services and internet on the growth of GDP of a country. The public and private players of this sector has improved a lot and on its way of growth and development. Hence, a study on financing efficiency of selected Indian telecommunication companies is very rewarding one.

2.3 MCDM methodology

The technique of selecting one best decision making units based on the set of criteria's is defined as multi criteria decision making. It transforms multiple criteria in to single criteria decision making and makes it is easier to identify the best alternative. There are multiple steps in MCDM models which includes weight determination, normalization process aggregation and selection. It is described as follows

$$D = [X_{pq}]mxn \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$W = [W_q]n \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where D is decision Matrix, W is the weight vector m is that number of alternatives and n is the number of criteria's considered.

The decision making Matrix normally consist of different unit of measurement. Therefore, by using normalization procedure, data should be converted into a comparable value. **Zavadskas and Turskis (2008)**[6] provides various normalization procedures. In MCDM model evaluation criteria's used can be classified into benefit and cost criteria's for benefit, criteria higher rate is consider in the model. The weight of criteria considered in selecting the most disable alternatives.

2.4 Literature Reviews

There are number of research studies have approached various MCDM methods in the financial performance evaluations and ranking the alternatives. This is due to its features such as easy to reach the decision, limited input requirements and provides the performance measurement of every alternatives **(yeh,2002)**[7].

The TOPSIS model applied to the evaluation of cement companies **(Kuo et al.,2008)**[8], **Ching et al., 2010**[9], **Sahar Omrani et al., 2019**[10], **Ertugrul and karakkasoglu, 2009**[11]) financial performance of steel companies **(Raikar, 2018)**[12], performance of banking sector **(Yalcin et al., 2012**[13], **Aditi Sharma et al.,2018**[14], **Akkooc and vatanserver, (2013)**[15], **mandic et al., 2014**[16], **Tugba sari and Ihsan erdem kayral., 2019**[17], **Dragisa stanujkie et al., 2013**[18], **Siew et al., 2017**[19] **and sajkinc,2016)**[20], **ranking of suppliers (wang,2008)**[21] financial performance of firms **(Liew kah fai et al., 2016**[22], **Bulgurcu, 2012**[23], **Kazan and Ozdemir, 2014**[24], **Ergul and ve Akel, 2010**[25], **Turkmen and Cagil, 2012**[26], **Hasanloo et al., 2013**[27]**).** Raking of retail industry **(Ozguven, 2011)**[28], financial performance of factoring industry **(Deger Alpher and Canan Baster,2017)**[29] performance of automotive industry **(Yurdakul and Ve/Ic, 2003**[30], **Moradi and Janatifar, 2014)**[31], financial performance of container shipping company **(Wang, 2014)**[32], evaluation of financial performance of REIT's **(Onder, Tas and Hepsen, 2014**[33] **and mahmat Islamoglu et al., 2015)**[34], performance of airline companies **(Feng and Ve Wang, 2000)**[35]. Evaluvation of food industries **(Kalogeras et al., 2005)**[36], performance of real estate investment companies **(Kim et al., 1997)**[37], evaluation of technology firms, **(Berna Bulgurcu, 2012)**[38], Perfrmance of metal companies **(Majtaba Farrokh et al., 2016)**[39], selection of suppliers **(Lee et al, 2015)**[40]. Financial performance of lodging companies **(Yilmaz and Konyar, 2013)**[41], financial evaluation of pension companies **(Isseveroglu and Sezer, 2015)**[42]. Performance of Textile firms **(Cam et al., 2015)**[43], performance of IT companies **(Inani and Gupta, 2018)**[44], financial performance of paper industry **(UCUACU, 2018)**[45] and assessment of financial performance of Indian pharmaceutical companies using TOPSIS Method **(Dr.A.Vijayakumar and V.Sudhirkumar, 2020)**[46].

2.5 TOPSIS- technique for order preference by similarity to ideal solution

Under this method, best alternative had been chosen based on its distance from ideal solution. The closer to positive ideal solution and the longer to the negative ideal solution is preferred. The TOPSIS method was introduced by **Hwang and Yoon**[47] in the year 1981. It is primarily compare benefits and costs of each criterion. The positive ideal solution is determined at a point with higher benefit and lower the cost whereas negative ideal solution with lower benefit and higher the cost. The alternative which is more close to positive and the long distance from the negative ideal solution is selected.

The steps involved in this method are given below:

Step 1: Develop the decision making matrix

In MCDM problem, the decision making matrix D is with m alternative n criteria

$\left[R = \left\{\frac{Ri}{i} = 1,2 \ldots . m\right\}\right] and\ C = \left\{\frac{Ci}{i} = 1,2 \ldots n\right\}]$, is given below

$$D = \begin{array}{c} \\ R_1 \\ R_2 \\ \vdots \\ \cdot \\ R_i \\ \vdots \\ R_m \end{array} \begin{array}{c} \begin{array}{cccccc} C_1 & C_1 & \ldots & Cj & \ldots & C_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \ldots & x_{1j} & \ldots & x_{1n} \\ x_{21} & x_{22} & \ldots & x_{2j} & \ldots & x_{2n} \\ \vdots & \vdots & & \vdots & & \vdots \\ . & . & & . & & . \\ x_{i1} & x_{i2} & \ldots & x_{ij} & \ldots & x_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ x_{m1} & x_{m2} & \ldots & x_{mj} & \ldots & x_{mn} \end{bmatrix} \end{array} \quad \ldots\ldots\ldots\ldots 3$$

Step 2: Determining normalized decision matrix ®

Normalized matrixes preferably by vector normalization method are other appropriate method of normalization. If the vector normalization method is used, then the equation would be

$$R = \left[x_{ij}\right] = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} \left(x_{ij}\right)^2}} \text{ If benefit criteria} \quad \ldots\ldots\ldots\ldots\ldots 4$$

$$= R = \left[x_{ij}\right] = \frac{\sqrt{\sum_{i=1}^{m} \left(x_{ij}\right)^2}}{x_{ij}} \text{ If cost criteria} \quad \ldots\ldots\ldots\ldots\ldots 5$$

Step 3: Developing the weighted normalized decision Matrix

The normalized weighted decision matrix is developed based on weights of each criterion. By adopting entropy method, weights of each criterion's are determined. Each element in R Matrix is multiplied by the respective W_q value. The resultant Matrix V is obtained.

$$= \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1j} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2j} & \cdots & v_{2n} \\ \vdots & \vdots & & \vdots & & \vdots \\ . & . & & . & & . \\ v_{i1} & v_{i2} & \cdots & v_{ij} & \cdots & v_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ v_{m1} & v_{m2} & \cdots & v_{mj} & \cdots & v_{mn} \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots 6$$

Step 4: Computing positive ideal solution and negative ideal solution

The positive and negative ideal solution is computed for each benefit and cost criteria based on the following norms from the weighted normalized matrix.

Positive Ideal Solution: $A^+ = v_1^+, v_2^+ \ldots\ldots\ldots\ldots\ldots\ldots\ldots v_n^+$:

$$V_j^+ = \begin{cases} \max Vij, j \in N, i = 1,2,\ldots.m \text{ for benifit criteria} \\ \min Vij, j \in N, i = 1,2,\ldots.m \text{ for benifit criteria} \end{cases} \quad \ldots\ldots\ldots\ldots 7$$

Negative Ideal Solution: $A^- = v_1^-, v_2^- \ldots\ldots\ldots\ldots\ldots\ldots\ldots v_n^-$:

$$V_j^- = \begin{cases} \max Vij, j \in N, i = 1,2,\ldots.m \text{ for benifit criteria} \\ \min Vij, j \in N, i = 1,2,\ldots.m \text{ for benifit criteria} \end{cases} \quad \ldots\ldots\ldots\ldots 8$$

Step 5: Calculation of the distance

The distance from the positive ideal and negative ideal solution is measured with help of the following equation by using the two Euclidean distances for every alternative.

$$S_j^+ = \sqrt{\sum_{i=1}^{m} (= v_{ij} - v_j^+)^2}, i = 1,2,\ldots.m \quad \ldots\ldots\ldots\ldots 9$$

$$S_j^- = \sqrt{\sum_{i=1}^{m} (= v_{ij} - v_j^-)^2}, i = 1,2,\ldots.n \quad \ldots\ldots\ldots\ldots 10$$

Step 6: Calculation the closeness co- efficient

Based on equitation (11) the closeness co-efficient (C_i^*) is determined. The closeness co efficient C_i^* ranged as $0 \leq C_i^* \leq 1$. The alternatives are ranked according to its closeness co-efficient. The unit of which has the highest closeness co-efficient value considered to be the best alternative and ranked accordingly.

$$C_i^* = \frac{(s_i^{**})}{(s_i^+) + (s_i^-)} \quad \ldots\ldots\ldots\ldots 11$$

2.6 Weighting by entropy method

Entropy is an important weighting method used in the social and physical sciences. **(Capocelli and De Luca,1973)**[48]. **Jaynes, 1957**[49] viewed that the entropy measures the uncertainty presented in each criteria's. It is one of the important objective waiting methods. It should be useful to evaluate the decision Matrix with relative weights. **(Deng et al., 2000)**[50]. The entropy concept was defined by **Shannon (1948)**[51] and given as follows.

$$S(P1, P2 \ldots Pn) = -K \sum_n^n P_j I_n P_j \quad \ldots\ldots\ldots\ldots 12$$

Where k is a constant coefficient. Further, the entropy expression is first found in statistical mechanics, it is called entropy of pi probability distribution. When all pi values takes pi=1/n and S has the greatest uncertainty.

Entropy is used as the tool for examining criteria **(Zeleney, 1974**[52]**, Nijikamp, 1977)**[53] if given a decision Matrix consists of certain alternatives. It is to evaluate that contrast between the datasets. The uncertainty of data set and its variance is measured through entropy method. The value of the variation in the total variance gives the weight value of the each criterion. The decision Matrix normally comprises of various kinds of information and entropy is used as technique for criteria evaluation.

The procedure for determining the weighted value for the criteria by the entropy method is given below:

Let mxn-dimensional decision Matrix with m alternative and n criteria is determined.

$$D = \begin{matrix} A_1 \\ A_2 \\ \vdots \\ \cdot \\ A_i \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2n} \\ \vdots & \vdots & & \vdots & & \vdots \\ . & . & & . & & . \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \vdots & & \vdots & & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \text{mxn}$$

Where, X_{ij} -the success value. The values in row A_i indicate success values according to the all criteria of the i^{th} alternative, and the values in column x_j indicate the success values of all the alternatives according to the j^{th} criterion.

Step1: Each criteria has different scales, the normalization process is made in order to make comparative evaluation. The normalized decision making Matrix $R=[r_{ij}]$mxn is determined.

$$r_{cj} = \frac{x_{ij}}{\sum_{p=1}^{m} x_{pj}}, i = 1,2,\ldots m, j = 1,2,\ldots n$$

The purpose of normalization is to remove scaling effects between the various criteria.**(Caliskan,2013)**[54].

Step 2: The uncertainty measures for each criterion, entropy value, is found by the following equation

$$e_j = -K \sum_{i=1}^{m} r_{ij} In\, r_{ij}, j = 1,2,\ldots n$$

Where $K=\frac{1}{\ln(m)}$ is constant coefficient and $0 \leq e_j \leq 1$ are guaranteed. The value of e_j is the uncertainty measure of the j^{th} criterion or in other words, the entropy value.

Step 3: The degree of diversification dj is obtained by using the entropy value for each criteria as follows: **Step 4:** Finally, the weight values of the each criteria is determined by taking the proportion of the degree of diversification of the each criterion to the sum of the degree of diversification of all the criteria's.

$$w_j = \frac{d_j}{\sum_{p=1}^{n} d_p}, j = 1,2,\ldots n$$

As addition $\sum_{p=1}^{n} W_j = 1$ is clear.

2.7 Sample Selection

The list of companies considered in the analysis is given in the Table 1 along with DMU number.

Number of decision Units(DMU)	Name of the telecommunication companies
DMU 1	BSNL
DMU 2	MTNL
DMU 3	AIRTEL
DMU 4	TATA
DMU 5	IDEA
DMU 6	Reliance

Table-1
List of companies used in financial analysis

2.8 Period of the study and sources of data

The period of the study is in the year 2007-08 to2018- 19. The data required for this study is collected from the database of annual reports of the Selected Telecommunication Companies.

3. Results

The study determined ranking of selected Indian telecommunication companies evaluated on various criteria. The various criteria adopted in this study is presented in Table2. The various financial ratios considered in this study in such a way to provide information about earning capacity, utilisation of resources, financial soundness and paying ability, debt coverage, management efficiency and investment valuation figures of the company.

Sl.No	Criteria/ratio	Sub-criteria	Objective Weights	Type of Criteria
1	Earning capacity	Operating profit margin(OPM)	**0.24**	+
		Net profit margin(NPM)	**0.04**	+
2	Utilization of resources	Return on capital employed (ROCE)	**0.02**	+
		Return on Net Worth(RONW)	**0.01**	+
3	Financial soundness and paying ability	Current Ratio(CR)	**0.01**	+
		Quick Ratio(QR)	**0.17**	+
		Debt Equity Ratio(DER)	**0.23**	+
4	Debt coverage	Interest Coverage Ratio(ICR)	**0.06**	+
5	Management efficiency	ITR Turnover Ratio(ITR)	**0.01**	+
		RTR Turnover Ratio(RTR)	**0.00**	+
		Fixed assets Turnover Ratio(FATR)	**0.01**	+
		Total assets Turnover Ratio(TATR)	**0.02**	+
		Working Capital Ratio(WCR)	**0.02**	+
6	Investment valuation	Earnings Per Share (EPR)	**0.02**	+
		Book value Per Ratio(BVPR)	**0.03**	+
		Dividend Yield Ratio(DYR)	**0.08**	+
+denotes Benefit Criteria –Cost Criteria				
*Weights are determined based on Entropy Method				

Table 2
Ratios or criterion used in the analysis along with the Type and Weights of Criterion

3.1 Developing of decision making matrix

The matrix is developed firstly in TOPSIS method. The selected Indian telecommunication Companies that have decision points which obtained based on the evaluation criteria's. In this study, 6 decision making (alternatives) and (16) evaluation criteria's were used. The standard decision making matrix was set with dimension (6X16) obtained from selected Indian telecommunication companies. It is presented in Table 3.

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
DMU 1	17.56	-22.15	-4.85	-28.64	1.17	1.04	0.48	-0.03
DMU 2	0.033	-44.41	5.75	26.07	.59	0.57	-1.00	-0.44
DMU 3	72.18	-7.43	20.4	15.97	.50	0.50	0.75	42.54
DMU 4	55.98	121.05	-7.27	52.56	.28	0.28	-2.58	-29.91
DMU 5	-802.77	-504.44	.33	-13.72	.57	0.57	1.84	.94
DMU 6	-42.29	289.54	1.39	-1.71	1.25	1.23	1.74	3.30

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
DMU 1	18.50	7.41	.40	.23	-1.10	-11.50	835.57	.88
DMU 2	61.54	4.00	.56	.30	-.38	-26.94	35.85	0.00
DMU 3	6623.45	18.47	.83	.88	-3.65	15.63	177.93	109.20
DMU 4	605.97	11.28	.64	.48	-.09	-4.53	72.65	2202.30
DMU 5	396.20	29.71	.67	.52	-.46	.24	49.03	3.02
DMU 6	51.71	6.42	.33	.16	-1.06	-2.17	140.18	2.58

Source: Annual Reports of the respective companies.

Table3
Decision Making Matrix

3.2 Normalised decision making matrix.

To remove the scaling effects among the various criteria the normalisation process is adopted and normalised decision making matrix is obtained. In spite of large number of normalisation techniques available. In this study used the vector normalisation method. Under this method, the normalised decision matrix was found as per the equation (4) and (5). It is created by means of rij values computed separately for benefit and cost criteria. It is described in Table 4.

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
DMU 1	0.38	0.82	1.02	11.95	0.70	0.57	0.06	0.00
DMU 2	0.00	3.31	1.44	9.91	0.17	0.17	0.26	0.00
DMU 3	6.44	0.09	18.16	3.72	0.13	0.13	0.15	34.73
DMU 4	3.87	24.58	2.30	40.26	0.04	0.04	1.73	17.17
DMU 5	796.34	426.80	0.00	2.74	0.17	0.17	0.88	0.02
DMU 6	2.21	140.61	0.08	0.04	0.79	0.81	0.78	0.21

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
DMU 1	0.05	1.44	0.11	0.05	0.30	3.94	801.69	0.00
DMU 2	0.57	0.42	0.22	0.07	0.04	21.61	1.48	0.00
DMU 3	6583.72	8.91	0.47	0.65	3.33	7.27	36.35	5.41
DMU 4	55.11	3.33	0.28	0.19	0.00	0.61	6.06	2199.60
DMU 5	23.56	23.08	0.31	0.23	0.05	0.00	2.76	0.00
DMU 6	0.40	1.08	0.07	0.02	0.28	0.14	22.56	0.00

Source : Computed.

Table 4
Normalized Making Matrix

3.3 Determining weighting of normalised decision making matrix

The weight computed by following entropy method implies that a relative priority of different criteria's considered for assessment of financial performance by the researchers. The weighted measures of each criteria presented in Table 9 to 11. The magnitude of the weight value reflects the importance of the criterion. It is observed from the Table 2 that operating profit margin, net profit margin, investment turnover ratio and dividend yield ratio have the highest- weightier values among the all the criteria's.

By multiplying normalised data matrix by the relative weights, the normalised weighted data matrix is obtained. It is indicated in Table 5.

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
Weights	**0.06**	**0.24**	**0.04**	**0.02**	**0.01**	**0.01**	**0.17**	**0.23**
DMU 1	0.02	0.20	0.04	0.19	0.00	0.00	0.01	0.00
DMU 2	0.00	0.81	0.05	0.16	0.00	0.00	0.05	0.00
DMU 3	0.39	0.02	0.65	0.06	0.00	0.00	0.03	8.00
DMU 4	0.23	5.99	0.08	0.64	0.00	0.00	0.30	3.95
DMU 5	47.97	104.07	0.00	0.04	0.00	0.00	0.15	0.00
DMU 6	0.13	34.29	0.00	0.00	0.00	0.00	0.14	0.05

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
Weights	**0.06**	**0.01**	**0.00**	**0.01**	**0.02**	**0.02**	**0.03**	**0.08**
DMU 1	0.00	0.01	0.00	0.00	0.01	0.09	23.54	0.00
DMU 2	0.03	0.00	0.00	0.00	0.00	0.51	0.04	0.00
DMU 3	386.49	0.09	0.00	0.00	0.08	0.17	1.07	0.41
DMU 4	3.23	0.03	0.00	0.00	0.00	0.01	0.18	167.47
DMU 5	1.38	0.23	0.00	0.00	0.00	0.00	0.08	0.00
DMU 6	0.02	0.01	0.00	0.00	0.01	0.00	0.66	0.00

Source: Computed.

Table 5
Weighted Normalized Decision Making Matrix

3.4 Calculation of positive ideal Solution (V+)and negative ideal solution (V-)

The solution sets of V+ and V- are first constituted for selected Indian telecommunication companies. The positive ideal values is obtained as the maximum value for benefit criteria and minimum value for cost criteria of each column of the weighted normalised decision matrix((V+). Similarly, the negative ideal value is obtained as the minimum value for benefit criteria and maximum values for cost criteria on the normalised decision making matrix (V-). The V+ and V- values are given in Table 6.

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
POSITIVE	47.97	104.07	0.65	0.64	0.00	0.00	0.01	8.00
NEGATIVE	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
POSITIVE	386.49	0.09	0.00	0.00	0.08	0.51	23.54	167.47
NEGATIVE	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00

Source : Computed.

Table 6
Positive Ideal solution (V+) and Negative Ideal solutions (V-)

3.5 Calculation of separation measures

The distance between alternatives from the positive ideal solution and negative ideal solution is determined via equation (9) and (10). It is presented in Table 7.

Company	Distance from Positive Ideal Solution	Distance from Negative Ideal Solution
DMU 1	436.53	23.50
DMU 2	437.00	0.84
DMU 3	203.73	386.57
DMU 4	399.18	167.65
DMU 5	420.67	114.43
DMU 6	430.29	34.10

Source: Computed.

Table 7
Distance from Positive and Negative Ideal Solution

3.6 Computation of closeness co – efficient

The closeness co- efficient of each alternatives to the ideal solution (Vj*) is calculated as per the equation (11) and presented in Table 8. It is ranged between 0 to 1. **(Jafarnejad and Salimi, 2013)**[54].It is inferred that the larger the value means closer to ideal solution for decision making units

Company	Closeness co-efficient	Rank
DMU 1	0.05	5
DMU 2	0.01	6
DMU 3	0.65	1
DMU 4	0.30	2
DMU 5	0.21	3
DMU 6	0.07	4

Source : Computed.

Table 8
Closeness co-efficient

It is observed the Table that Airtel showed the best performance among the selected Indian telecommunication companies, followed by TATA and IDEA. Reliance, BSNL and MTNL are occupied least performance during the study period.

4. Discussion and conclusion

While assessing the financial performance of selected Indian telecommunication companies, the study to take not only a single criterion and also consider number of other relevant criterions that affects its performance. Therefore, in these study MCDM techniques is used in examining corporate performance. The study analysed 2008 to 2019 financial performance of 6 selected Indian telecommunication companies by adopting TOPSIS method. The results of the study point that Airtel had the best performance of the study period. MTNL had the least performance of the study period. Its concluded from the evaluation that some of the selected companies have performed well and others performed poorly due to their inconsistence performances. It should explore the condition high to least performances. The least performance companies well adopt strategies for success in order to improve their position. The scope of this study is limited to selected Indian telecommunication companies. The larger no of other industries, different criteria, different period of intervals and different data are described as the scope for future research.

REFERENCES

1. Sahar Omrani, Mostafa Jafari & As Mansori(2019) Analysis of Financial Performance of Cement Industry manufacturing companies in Tehran Stock Exchange Using the FAHP technique and TOPS Method Independent Journal of Management & Production, 10(2), 512-516
2. Turkis. Z. Zavadska E. K. & Peldschus, F.(2009) Multi-Criteria optimization system for decision making in construction design and management. Engineering Economics, 1.7-17
3. Zavska E. K. & Turkis, Z (2010). A new additive ratio assessment method in multi criteria decision-making, Ukio Technologinis ir Ekonominis Vystymas, 16(2), 159-172, doi: 10.3846/tede.2010.10
4. Citron, D.(1992) Financial ratio covenants in UK bank loan contracts and accounting policy choice, Accounting and Business research, 22(88), 322-336
5. Uygunturk, H. & Korkmaz, T. (2012) Finansal Performansin TOPSIS Çok Kriterli Karar Verme Yöntemi lie Belirlenmesi: Ana Metal Sanayi Işletmeleri Üzerine Bir Uygulama, Eskişehir Osmangazi Universitesi iktisadi ve Idari Bilimler Dergisi, 7(2),. Retrieved from https://dergipark.org.tr/tr/pub/oguiibf/issue/5716/76315.
6. Zavadskas, E.K., & Turskis, Z. (2008). A new logarithmic normalization method in games theory. Informatica, 19(2), 303-314, doi:10.15388/Informatica.2008.215
7. Yeh,CH.,(2002). A Problem Based Selection of Multi-Attribute Decision-Making Methods, Journal of International Transactions in Operational Research, 9, 169-181
8. Kuo,Y.,Yang,T., & Huang,G (2008). The use of grey relational analysis in solving multiple attribute decision making problems, submitted to Symbiosis International University.
9. Ching, C.H., Lin, J.J, Lin, JH & Chiang, M.C. (2010) Domestic open-end equity mutual fund performance evaluation using extended TOPSS method with different distance approaches, Expert Systems with Applications, 37(6), 4642-4649.
10. Sahar Omrani, Mosttafa Jafari & Ali Mansori(2019). Op.cite
11. Ertugrul,l, & Karakasoglu,N. (2009), Performance Evaluation of Turkish Cement firms with fuzzy analytic hierarchy process and TOPSIS methods, Experts Systems with Applications, 36(1), 702-715.
12. Avinash V. Raikar (2018). An assessment of financial performance of selected steel manufactures in India with MCDM technique of MOORA and TOPSIS with Critic based weight determination, International Journal of current Advanced Research, 8(3), 17836-17843
13. Yaicin, N. Bayrakdaroglu,A., & Kahraman,C. (2012). Application of fuzzy multi-criteria decision making methods for financial performance evaluation of Turkish manufacturing industries, Experts Systems Applications, 39(1), 350-364.
14. Sharma,A., Kaur, G., & Bansal, J. (2018). Proceedings of the First International Conference on informationTechnology and Knowledge Management, 145-150.
15. "Akkoc. S. & Vatanserver, K. (2013). Fuzzy Performance Evaluation with AHP and TOPSIS Methods: Evidence from Turkish Banking Sector after the Global Financial Crisis, Eurasian Journal of Business and Economics, 6(11), 53-74
16. Mandic, K. Delibasic, B., Knezevic, S., & Benkovic, S (2014) Analysis of financial parameters of Serbian Banks through the application of the Fuzzy AHP and TOPSIS methods, Economic Modelling 43,30-37
17. Sari T. & Kayral, E. (2019) Performance Evaluation of Turkish Banks with TOPSIS and Stepwise Regression International Conference on Research in Business, management & Finance, Amsterdam, NETHERLANDS
18. Stanujkic, D. Dordevic B & Dordevic M (2013) Comparative Analysis of some prominent MCDM Methods: A case of Ranking Serbian Banks, Serbian Journal of Management, 8(2)
19. 213-241.
20. Siew Lam Weng, Liew Kah Fai & Lam Weng Hoe (2017) Evaluation of the Financial Performance of the Malaysian Banks with TOPSIS Model, American Journal of Service Science and management, 4(2),11-16
21. Sakinc,O.S (2016) Comparison of Turkish State Banks performance via Multi-criteria performance measurement method, international Journal of Scientific Research and Management, 4(11), 4857-4871.
22. Wang Y.I. (2008). Applying FMCDM to evaluate Financial Performance of Domestic Airlines in Taiwan Expert Systems with Applications, 34, 1837-1845.
23. Fai LK, Siew, LW., & Hoe LW (2016) Financial analysis on the company performance in Malaysia with Multi-Critena Decision Making Model, Systems Science and Applied Mathematics, 111, 1-7.
24. Bulgurcu,B.(2012) Application of TOPSIS Technique for financial performance evaluation of technology firms in istabul

Stock Exchange Market after Global Financial Crisis, Eurasian Journal of Business and Economics, 6111, 53-74.
25. Kazan, H. & Ozdemir, O. (2014). Financial Performance Assessment of Large Scale Conglomerates wa TOPSIS and Critic Methods, Journal of Management and Sustainability, 3(4), 203-224.
26. Ergul N., & Ve Akel, V. (2010) Finansal Kiralama Sirketlerinin Mali performansinim TOPSIS Yontemi ile Analizi, MODAV, 12(3), 91-118.
27. Turkmen.S.Y., & Cagil, G.C (2012) IMEB'ye Kote billsim sektoru sirketlerinin finansal performanslarin TOPSIS yontemi ile degerlendirilmesi, Maliye Finans Yazilari, 26(95), 59-78.
28. Hasanioo, S, Karim, E. Mehregan, MR, & Tehrani, A. (2013), Evaluating performance of Companies by new management tools, Journal of Natural and Social Sciences, 213), 165-169.
29. Ozguven, N. (2011). Kils doneminde kuresel perakendeci aktorlerin performanslarinin TOPSIS yontemi ile degerlendirilmes, Ataturk Universitesi iktisadi ve idari Bilimler Dergisi, 25(2), 151-162.
30. Alper D. & Basdar.C. (2017) A comparison of TOPSIS and Electre Methods: An application on the Factoring Industry, Business and Economics Research Journal, 8(3), 627-646.
31. Yurdakul, M.& K., YT, (2003). An illustrative Study Amed to Measure and Rank Performance of Turkish Automotive Companies using TOPSIS, IFAC Eng Arch Gazi Uni, 18(1), 1-18.
32. Moradi, M. & Janatifar, H. (2014) Performance evaluation of automobile companies based on multi criteria decision making technique, Global Journal of management studies and Researches. 1(2), 77-84.
33. Wang, Y. (2014). The evaluation of financial performance for Taiwan containers shipping companies by furry TOPSIS Applied Soft Computing, 22, 28-35.
34. Onder, E., Tas.N., & Hepsen, A. (2014), REIT's in Turkey Fundamentals vs. Market International Journal of Latest Trends Finance and Economic Sciences, 4(1) 662-676.
35. Islamoglu, M. Apan, M., & Ortel, A. (2015). An Evaluation of the financial performance of REITs in Borsa Istanbul A case study using the Entropy based TOPSIS Method, International Journal of Financial Research, 6:21 124-138.
36. Feng CM., and Ve Wang RT (2000) Performance evaluation for airlines including the consideration of financial ratios, Journal of Air Transport Management, 613), 133-142.
37. Kalogeras, N. Baourakis, C., Zopounidis, C., & Dijk, G.V. (2005). Evaluating Financial Performance of Agri-Food Firms: A multi criteria decision aid approach, Journal of FOOD Engineering, 70(3), 365-371.
38. Kim, G. Park, C. and Yoon, K.P. (1997) Identifying investment opportunities for advanced manufacturing system with comparative-integrated performance measurement, International Journal of Production Economics, 50(1), 23-33.
39. Bulgurcu, B. (2012). Application of TOPSIS Technique for Financial Performance Evaluation of Technology Firms In Istanbul Stock Exchange Market, Procrdia Social and Behavioural Sciences, 62, 1033-1040.
40. Farrokh, M., Heydari, H. & Janani, H. (2016). Two comparative MCDM approaches for evaluating the financial performance of Iranian basic metal companies, Iranian Journal of Management Studies, 9(2). 359-382.
41. Lee, J., Cho, H. & Kim, Y.S. (2015). Assessing business impacts of agility criterion and order allocation strategy in multi-criteria supplier selection, Expert Systems with Applications, 42(3), 1130-1148.
42. Yilmaz, B.B., & Konyar, A.M. (2013). Financial performance evaluation of publicly held lodging companies listed in Istanbul Stock Exchange with TOPSIS method, European Journal of Scientific Research, 95(1), 143-151.
43. Isseveroglu, G., & Seezer, O. (2015). Financial performance of pension companies operating in Turkey with TOPSIS analysis method, International Journal of Academic Research in Accounting, Finance and Management Sciences, 5(1), 137-147.
44. Cam A.V., Cam, H., Ulutas, S. & Sayin.O.B. (2015). The role of TOPSIS method on determining the financial performance ranking of firms: An application in the Borsa Istanbul, International Journal of Economics and Research, 6(3),29-38.
45. Inani, S.K., & Gupta, R. (2017). Evaluating Financial performance of Indian IT Firms: An application of multi- criteria decision making technique, International journal of Behavioral Accounting and Finance, 6(2), 126-139.
46. Ucuncu, T., Akyuz, K.C. Akyuz, L. Bayram, B.C., & Ersen, N. (2018). Evaluation of financial performance of paper companies traded at BIST with TOPSIS method, Kastamonu University Journal of Forestry Faculty, 18(1), 92-98.
47. Hawang, CL, and Yoon, K. (1981). Multiple Attribute Decision-manking methods and Applications, Springer -Verlag, Berlin.
48. Capocelli, R. M., & De Luca, A. (1973), Fuzzy sets and Decision Theory. Information and Control, 23(5). 446-473.Retrieved from https://doc.org/10.1016/0019.9958(73)80009-9. doi:10.1016/50019.058(73)80009-9
49. Jaynes, E. T. (1957). Information theory and statistical mechanics. Physical Review, 106(4), 620-630. doi:10.1103/PhysRev.106.620
50. Deng, H., Yeh, C.H., & Willis, R. J. (2000). Inter-company comparison using modified TOPSIS with objective weights. Computers and Operations Research, 27(10), 963-973.http:/.Retrieved from https://dx.doc.org/10.1016/S0305-0548(99)00069-6. doi:10.1016/S0305-0548(99)00069-6
51. Shannon, C. E. (1948). A mathematical theory of communication. Bell System Technical Journal, 27(3), 379- 423. doi:10.1002/1538-7305.1948 1601338.x
52. Zeleny, M. (1974). Linear Multi objective programming. Berlin: Springer-Verlag.
53. Nijkamp, P. (1977), Stochastic quantitative and qualitative multi criteria analysis for environmental design. Papers in Regional Science, 39(1), 175-199. Retrieved from https://doc.org/10.1007/BF01936213
54. Çahşkan,H.(2013).Selection of boron based tribological hard coatings using multi-criteria decision- making methods. Materials and Design, 50, 742-749, doi:10.1016/j.matdes.201303.059lj matdes. 2013.03.059.
55. Jafarnejad, A. Salimi, M., (2013). Grey TOPSIS Method for supplier selection with literature and Delphi criteria in an Auto company, Academic Arena, 5(12).

Note:
The process of determining the weighted value for the criteria by the entropy method is as follows.

Table 9
Normalised decision matrix for weight determination under entropy method

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
DMU 1	-0.03	0.13	-0.31	-0.57	0.27	0.25	0.39	0.00
DMU 2	0.00	0.26	0.36	0.52	0.13	0.14	-0.82	-0.03
DMU 3	-0.10	0.04	1.29	0.32	0.11	0.12	0.61	2.59
DMU 4	-0.08	-0.72	-0.46	1.04	0.06	0.07	-2.10	-1.82
DMU 5	1.15	3.01	0.02	-0.27	0.13	0.14	1.50	0.06
DMU 6	0.06	-1.73	0.09	-0.03	0.29	0.29	1.41	0.20

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
DMU 1	0.00	0.10	0.12	0.09	0.16	0.39	0.64	0.00
DMU 2	0.01	0.05	0.16	0.12	0.06	0.92	0.03	0.00
DMU 3	0.85	0.24	0.24	0.34	0.54	-0.53	0.14	0.05
DMU 4	0.08	0.15	0.19	0.19	0.01	0.15	0.06	0.95
DMU 5	0.05	0.38	0.20	0.20	0.07	-0.01	0.04	0.00
DMU 6	0.01	0.08	0.09	0.06	0.16	0.07	0.11	0.00

Source: Computed

Table 10
Value of entropy

	Value of entropy		
In(6)	10.7		
h=1/ln(6)	0.56	(-h) =	-0.56

Source: Computed

Table 11
Determination of Weights

Company	OPM	NPM	ROCE	RONW	C.R	Q.R	DER	ICR
DMU 1	-0.09	-0.27	-0.36	-0.32	-0.35	-0.35	-0.37	-0.01
DMU 2	0.00	-0.35	-0.37	-0.34	-0.27	-0.27	-0.17	-0.10
DMU 3	-0.23	-0.14	0.33	-0.36	-0.25	-0.25	-0.30	2.47
DMU 4	-0.20	-0.24	-0.36	0.04	-0.18	-0.18	1.55	1.10
DMU 5	0.16	3.31	-0.08	-0.35	-0.27	-0.27	0.60	-0.16
DMU 6	-0.17	0.94	-0.21	-0.11	-0.36	-0.36	0.49	-0.32
sum	-0.54	3.26	-1.05	-1.46	-1.67	-1.68	1.81	2.97
ej= (-h*sum)	0.30	-1.82	0.59	0.81	0.94	0.94	-1.02	-1.67
d=(1-ej)	0.70	2.82	0.41	0.19	0.06	0.06	2.02	2.67
weights	**0.06**	**0.24**	**0.04**	**0.02**	**0.01**	**0.01**	**0.17**	**0.23**

Company	ITR	RTR	FATR	TATR	W.C.R	EPS	BVPR	DYR
DMU 1	-0.01	-0.22	-0.25	-0.22	-0.30	-0.37	-0.29	0.00
DMU 2	-0.04	-0.15	-0.30	-0.25	-0.16	-0.08	-0.10	0.00
DMU 3	-0.13	-0.34	-0.34	-0.37	-0.33	-0.34	-0.27	-0.14
DMU 4	-0.20	-0.28	-0.31	-0.31	-0.06	-0.29	-0.16	-0.05
DMU 5	-0.15	-0.37	-0.32	-0.32	-0.18	-0.04	-0.12	-0.01
DMU 6	-0.03	-0.21	-0.22	-0.17	-0.29	-0.19	-0.24	-0.01
sum	-0.57	-1.58	-1.75	-1.64	-1.32	-1.30	-1.18	-0.21
ej= (h*sum)	0.32	0.88	0.98	0.92	0.74	0.73	0.66	0.12
d=(1-ej)	0.68	0.12	0.02	0.08	0.26	0.27	0.34	0.88
weights	**0.06**	**0.01**	**0.00**	**0.01**	**0.02**	**0.02**	**0.03**	**0.08**

Source: Computed